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APPALACHIA PROGRAM, WATER SUPPLY AND WATER QUALITY CONTROL NEEDS, ST. PETERSBURG RESERVOIR, CLARION RIVER, PENNSYLVANIA, ALLEGHENY RIVER BASIN

Federal Water Pollution Control Administration
Wheeling, West Virginia

December 1967

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APPALACHIA PROGRAM

WATER SUPPLY AND WATER QUALITY CONTROL NEEDS

ST. PETERSBURG RESERVOIR

CLARION RIVER, PENNSYLVANIA

ALLEGHENY RIVER BASIN

prepared for

U. S. DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS-APPALACHIA STUDY
U. S. ARMY ENGINEER DISTRICT
PITTSBURGH, PENNSYLVANIA

by

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION
WHEELING FIELD STATION

December 1967

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Request and Authority

In a letter dated 3 March, 1967, the U. S. Army Corps of Engineers District Engineer, Pittsburgh District, requested the Federal Water Pollution Control Administration to study the proposed St. Petersburg Reservoir Project with respect to potential water development for water supply and water quality control.

This report was prepared under the authority of the Appalachian Regional Development Act of 1965, P. L. 89-4, Section 206C.

Purpose and Scope

The purpose of this investigation was to determine the need for and value of water supply and/or water quality control storage in the proposed St. Petersburg Reservoir, located on the Clarion River in Clarion County, Pennsylvania. Economic projections were based upon the developmental benchmarks supplied by the U. S. Army Corps of Engineers, Pittsburgh District.

In analyzing water supply and water quality control needs consideration was given to present and potential water users and waste sources along the Allegheny River from the Allegheny River Reservoir near Warren, Pennsylvania, to Pittsburgh, Pennsylvania; the Ohio River from Pittsburgh, Pennsylvania, to the Pennsylvania-West Virginia state line, and areas adjacent to the proposed St. Petersburg Reservoir. The study was focused on the lower reaches of the Allegheny River and the Ohio River in the vicinity of Pittsburgh, Pennsylvania and this area presently has an established large municipal and industrial complex.

Summary of Findings

The existing water resources, with Allegheny River Reservoir in operation, can adequately meet the projected municipal and industrial water supply requirements of the study area.

The present stream flow conditions of the Allegheny River can adequately provide proper assimilation of treated municipal and industrial wastes under present and projected economic conditions.

There is a need for storage to provide low flow augmentation for projected water quality control needs on the Ohio River near Pittsburgh, Pennsylvania. Computations indicate that about 110,000 acre feet of storage is required to meet these flow needs nine out of ten years as projected to the year 2020. The average annual benefit from providing such storage is $1,001,000.

The quality of water in the Clarion River is degraded by acid mine drainage and therefore storage for water quality control is not recommended in St. Petersburg Reservoir unless corrective measures are applied to the existing acid drainage sources.

Physical Data

The proposed St. Petersburg Reservoir dam site is located on the Clarion River near its mouth, about 2 miles east of the Allegheny River bridge at Foxburg, Pennsylvania. The proposed reservoir site has an approximate storage capacity of 800,000 acre feet at the full pool elevation of 1140 feet and would control a drainage area of 1231 square miles. A considerable portion of the proposed 800,000 acre feet is available as storage for water supply and/or low flow augmentation for water quality control.

The Clarion River joins the Allegheny River near Parker, Pennsylvania. The Allegheny is a free flowing river at that point, but soon becomes navigable in the vicinity of East Brady, Pennsylvania, which is located about 20 miles downstream from Parker. There are eight navigation structures on the Allegheny River between East Brady, Pennsylvania, and the point at which it joins the Monongahela River at Pittsburgh, Pennsylvania, a distance of 72 miles. Thus, the major portion of the Allegheny River below the proposed St. Petersburg Reservoir is a series of navigation pools.

There are several existing reservoirs located in the Allegheny and Monongahela basins, some of which have an effect on low flow conditions in the study area. Existing and authorized Corps of Engineers' reservoirs in the Allegheny basin are located on Figure 1. Table 1 presents a summary of physical data related to the reservoirs which have an effect on the surface water resources in the study area.

TABLE 1

RESERVOIR DATA

ALLEGHENY AND MONONGAHELA BASINS

Reservoir	Storage - Summer Season (1000 Ac. Ft.) Flood	Quality	Conservation	Total
Allegheny River 1/	607	549	24	1180
Conemaugh River 1/	270	---	4	274
Crooked Creek 1/	89	---	5	94
East Branch, Clarion River 1/	19	64	1	84
Loyalhanna 1/	93	---	2	95
Tionesta 1/	125	---	8	133
Rowlesburg* 2/	251	572	9	832
Tygart River 2/	178	100	10	288
Youghiogheny River 2/	100	149	5	254
Stonewall Jackson** 2/	27	46	2	75

*Authorized for construction on Cheat River
**Authorized for construction on West Fork River

1/ Allegheny River basin (See Figure 1.)

2/ Monongahela River basin (Not shown Figure 1.)

U. S. Geological Survey streamflow measuring stations are located at several points in the study area. A summary of low flow frequency data at key stations is given in Table 2. Allegheny River flow data is presented under natural conditions and as augmented by East Branch and Allegheny Reservoirs. Ohio River flow data is presented under natural flow conditions and with low flow augmentation from Tygart, Youghiogheny, East Branch, and Allegheny Reservoirs and the authorized Rowlesburg and Stonewall Jackson Reservoirs.

TABLE 2

LOW FLOW FREQUENCY DATA

	Allegheny River Kittanning, Pennsylvania		Allegheny River Natrona, Pennsylvania		Ohio River Sewickley, Pennsylvania	
	cfs	mgd	cfs	mgd	cfs	mgd
Minimum of Record	570	368	922	596	1800	1163
Mean 7 day, 10 year Frequency Low Flow						
Natural	750	484	900	581	1700	1098
Augmented	2300	1485	3000	1938	5000	3230
Mean 7 day, 30 year Frequency Low Flow						
Natural	610	394	720	465	1350	872
Augmented	2050	1324	2700	1744	4400	2840
Mean daily, 30 year Frequency Low Flow						
Natural	529	342	732	473		

Note: Period of record used in above analyses varies.

Economy

Pittsburgh, Pennsylvania, is the most highly populated and largest economic center in the study area. Here the Allegheny and Monongahela Rivers join to form the Ohio River, thus creating a vast potential for heavy water using industries along the three rivers.

Presently, the Pittsburgh area supports various industries, the bulk of which are primary metals production and fabrication, chemical production and research, and clay, stone and glass production. In recent years there has been a trend away from expansion of primary metals production toward the establishment of chemical industries. A recent article in the magazine Chemical Week (1) points out that "Pittsburgh has become Chemical City, with the largest conglomeration of chemical producers, builders and researchers in the country."

The concentration of industry decreases as one travels upstream along the Allegheny River. The portion of Allegheny River in Allegheny and Westmoreland Counties supports a variety of industries the largest of which are primary metal production and fabrication and stone, clay and glass production. In Armstrong County most industries along the Allegheny River are located in the communities of Ford City and Kittanning, Pennsylvania.

Table 3 presents a summary of the number and employment size of manufacturing plants located in the study area.

TABLE 3

NUMBER AND EMPLOYMENT SIZE OF MANUFACTURING PLANTS
(From McGraw-Hill Survey of Industrial Plants, 1964)
(Allegheny, Armstrong, Beaver, Butler, Clarion, Washington and Westmoreland Counties, Pennsylvania)

SIC		20-49	50-99	100-249	250-499	500-999	Over 1000	Total
20	Food and Kindred Products	66	24	20	6	5	1	122
22	Textile Mill Products	3	-	-	-	-	-	3
23	Apparel and Related Products	-	1	5	1	-	-	7
24	Lumber and Wood	-	-	2	-	1	-	3
25	Furniture and Fixtures	2	3	3	1	-	-	9
26	Paper and Allied Products	2	1	9	5	-	-	17
27	Printing and Publishing	-	-	10	2	2	1	15
28	Chemicals and Allied Products	29	8	16	2	1	-	56
29	Petroleum and Coal	1	2	3	3	-	-	9
30	Rubber and Plastics	8	6	2	2	1	-	19
32	Stone, Clay and Glass	9	11	30	12	12	1	75
33	Primary Metals	26	13	21	15	8	31	113
34	Fabricated Metals	63	40	25	14	5	4	151
35	Machinery, except Electrical	53	33	26	7	-	6	125
36	Electrical Machinery	14	9	8	3	3	8	45

TABLE 3 (continued)

SIC		20-49	50-99	100-249	250-499	500-999	Over 1000	Total
37	Transportation Equipment	5	3	2	1	-	4	15
38	Instruments and Related Products	5	7	3	-	-	2	17
39	Miscellaneous	5	5	5	4	-	-	19
	TOTAL	291	165	190	78	38	58	820

Population and industrial employment projections used in the analyses of potential water supply and water quality problems were based upon the developmental benchmark projections disaggregated to the county level by the Corps of Engineers. In analyzing potential problem areas, it was assumed that existing communities would grow at the same rate as indicated by their respective county population benchmarks.

A significant factor relating to the potential growth of large water using industries along the Allegheny River is the availability of flat land or flood plain adjacent to the river. The Allegheny River is relatively narrow as it cuts through the mountains and rolling hills of western Pennsylvania. Most of the suitable, large industrial sites have already been utilized for municipal and industrial growth. The Corps of Engineers, however, has supplied specific, potential sites on which industrial expansion is predicted. These sites range in size from 17 to 138 acres.

The bulk of growth is anticipated as new chemical producing industries. Since many of the potential sites are small in size, new industrial establishments will likewise be limited in production and future expansion.

Table 4 presents a summary of the net employment change from 1962 to 2020, by counties, for the large water using industries.

Table 5 presents the county population projections.

TABLE 4

SUMMARY OF NET EMPLOYMENT CHANGE
FROM 1962 TO 2020 BASED UPON
BENCHMARK PROJECTIONS

Industry	Net Totals	Allegheny	Armstrong	Clarion	Forest	Venango	Warren	Westmoreland
Food	+ 799	-425	+52	+862	-22	0	0	+ 332
Apparel	- 13	+20	0	0	0	-5	-24	-4
Paper	+2157	+465	0	+95	0	-1	0	2/ +1598
Chemicals	+18,449	1/ +11,767	+5918	+318	-9	+307	-33	+181
Petroleum	-1889	-440	-10	-10	0	-1088	-321	-20
Primary Metals	-22,629	-27,818	+1169	+237	+126	+977	+2680	0
Net Totals	-3126	-16,431	+7129	+1502	+95	+190	+2302	+2087

1/ 4613 along Monongahela River; 7154 in Allegheny River

2/ All along Monongahela River

TABLE 5

Benchmark Population Projections

County	1960	1980	2000	2020
Allegheny County	1,628,587	1,667,500	1,940,400	1,981,700
Beaver County	206,948	302,400	438,300	468,900
Washington County	217,271	257,200	325,600	506,100
Westmoreland County	352,629	418,900	532,200	831,000
Clarion County	37,408	56,400	70,000	174,300
Clarion Borough	4,958	8,800	17,000	57,000
Armstrong County	79,524	82,100	83,900	98,000
Butler County	114,639	170,200	469,000	516,000
TOTAL	2,637,006	2,954,700	3,859,400	4,576,000

Present Water Use

There are many communities along the Allegheny and Ohio Rivers which obtain their water supplies from either the ground water resources of alluvium deposits or surface sources. Table 6 presents a summary of the major communities which utilize these sources for their water supplies.

The community of Clarion, Pennsylvania, presently obtains its water supply from several wells which have a limited potential yield and the water is of relatively poor quality.

Water is pumped from the Allegheny River in the vicinity of East Brady, Pennsylvania, across the drainage divide to temporary storage reservoirs and used for industrial and municipal water supply at the community of Butler, Pennsylvania. According to the Pennsylvania Department of Forests and Waters, the maximum allowable extraction is presently 5.5 mgd. Since the users are located in the Beaver River Basin, this water is never returned to the Allegheny River.

The present industrial complex located along the lower reaches of the Allegheny River and the Ohio River in the vicinity of Pittsburgh, Pennsylvania, is the largest user of water in the study area. Only a small portion of the gross requirements for cooling and process water are lost to the basin as consumptive use. Thus water is reused by the various municipal and industrial users along the Allegheny and Ohio Rivers.

Present Water Quality

A study by the U. S. Geological Survey (2) indicates "the Allegheny River at Kittanning is.....generally of good quality and suitable for recreation, domestic use and most industrial purposes after moderate treatment".

TABLE 6

MUNICIPAL WATER USE

Municipality	Source	LOW FLOW mgd 1/		Present	1980	2000	2020
Pittsburgh	Allegheny	473	Pop. Served mgd	700,000 96.1	717,000 101.8	834,000 122.5	852,000 129.5
Wilkensburg	Allegheny	473	Pop. Served mgd	250,000 19.2	256,000 21.0	298,000 25.3	304,000 26.8
Tarentum	Allegheny	473	Pop. Served mgd	12,000 1.4	12,300 1.6	14,300 1.9	14,600 2.0
Oakmont	Allegheny	473	Pop. Served mgd	85,000 4.7	87,000 5.4	101,200 6.7	103,400 7.1
Brackenridge	Allegheny	473	Pop. Served mgd	5,200 1.5	5,320 1.6	6,190 1.9	6,330 2.0
Kittanning	Allegheny	342	Pop. Served mgd	9,000 1.4	9,290 1.5	9,500 1.6	11,100 1.9
Freeport	Allegheny	473	Pop. Served mgd	2,300 0.22	2,370 0.25	2,430 0.27	2,830 0.34
Butler	Lake Oneida Thorn Run Res. Allegheny River	2/ 10	Pop. Served mgd	42,000 5.5	62,200 8.6	172,000 24.7	189,000 28.4
Clarion	Wells 3/ Clarion River	1.7 15	Pop. Served mgd	5,000 0.53	8,850 1.1	17,150 2.2	57,500 7.7

1/ Mean daily, 30 year frequency low flow under natural conditions.
2/ Includes 5.5 mgd from the Allegheny River. The two reservoirs located in the Connoquenessing drainage have a combined capacity of 890 mgd.
3/ Clarion River could be used as alternate source.

Mineral quality in the Allegheny River at Natrona is influenced by the Kiskiminetas River.

The water quality of the Kiskiminetas River is seriously degraded by acid mine drainage from both active and inactive coal mining operations in the basin. The Allegheny River is therefore degraded to varying degrees depending upon the volume contributed by the Kiskiminetas River. The following analyses of the Allegheny River below the confluence of the Kiskiminetas River indicates the variance of the effect of the Kiskiminetas River on the quality of the Allegheny River.

pH	4.0 to 6.8
specific conductance	340 to 650 micromhos per cm.
hardness	115 to 240 mg/l (as $CaCO_3$)
sulfate	95 to 270 mg/l
manganese	1.6 to 5.2 mg/l

The U.S.G.S. report also states "although the Allegheny River at Natrona may be acidic and contain as much as 430 ppm dissolved solids during low flow, the Pennsylvania Fish Commission reports that the more hardy species of fish survive in the river from Pittsburgh to Freeport - trout and pike excepted". Many of the adverse quality conditions that are characteristic of the river during low flow can be altered by dilution when releases are made from the Allegheny River Reservoir. Experience has taught that when roughly 30 percent of the Allegheny flow originates from the Kiskiminetas River, fish kills can be expected. One million fish were killed in the Allegheny River below the Kiskiminetas, due to acid conditions, from August 19 to 23, 1966. (3) With the Allegheny River Reservoir now

in operation, most of the conditions which resulted in fish kills in the past are less likely to occur since low flow augmentation will increase Allegheny River flows.

A special study by the Wheeling Field Station (4) shows that in the Parker to Kittanning reach of the Allegheny, concentrations of manganese, phenols, biochemical oxygen demand, total iron, total coliform, fecal coliform, and fecal streptococci exceed maximum permissible limits.

The Ohio River at Rochester, Pennsylvania (25.2 miles downstream from confluence of the Allegheny and Monongahela Rivers) was found to have undesirable levels of specific conductance, manganese, sulfates, biochemical oxygen demand, total iron, total coliform, fecal coliform, phenols, surfactants (synthetic detergents), and total phosphate.

The intermittently degraded quality of the Allegheny River in its lower reaches is due largely to mine drainage discharges on its tributaries, especially the Kiskiminetas River and to the municipal and industrial complex in the Pittsburgh metropolitan area. Secondary treatment of municipal wastes and an equivalent degree of treatment for industrial organic wastes would allow the Allegheny River to meet the interstate dissolved oxygen standards adopted by the State of Pennsylvania now pending approval by the Secretary of the Interior.

Pennsylvania has initiated a 10 year acid mine drainage remedial program which should alleviate a large portion of the pollution from inactive mine sources in the Allegheny River basin. Correction of acid mine drainage from active mines is being accomplished through the existing Clean Streams Law.

Desirable water quality can be achieved in the Ohio River at Pittsburgh, under present conditions, by secondary treatment plus disinfection of

municipal wastes and an equivalent degree of treatment for industrial wastes. Mine drainage in the Monongahela River adversely affects water quality in the Ohio River at Pittsburgh. Pennsylvania's 10 year mine drainage remedial program applies also to the Monongahela River basin. However, it is believed that a Federally funded program will be needed both in West Virginia and Pennsylvania to bring mine drainage pollution under adequate control.

During 1966, the FWPCA conducted a stream water quality survey of the Clarion River area as part of the region-wide Appalachia Water Resources Survey. Special emphasis was given to areas whose water quality was known to be influenced by mine drainage.

The survey found the Clarion River to be discharging an average of 63 tons per day of net acidity to the Allegheny River. Acidity concentrations and pH values ranged from 25 to 40 milligrams per liter (mg/l) and from 4.1 to 5.3, respectively. The maximum alkalinity present in the Clarion River at its mouth was four mg/l. Total iron concentrations were only moderately high, averaging 0.7 mg/l during the survey, but manganese concentrations averaged 3.0 mg/l.

Because the observed alkalinity concentrations are not completely depleted, and, acidity concentrations are only moderately high, the stream's acid-alkaline ratio could be reversed in favor of the alkaline side with a reasonable amount of mine drainage remedial effort. Concentrations of associated mine drainage parameters would likewise be substantially reduced by the remedial effort.

The principal mine drainage problem areas in the Clarion basin are the watersheds of Toby Creek (Clarion County), Licking, Deer, Mill, and Piney Creeks, and, Toby Creek (Jefferson County). These tributaries are largely responsible for the residual water quality effects observed in the lower reach of the Clarion River. An aggregate net acid load of 65 tons per day was discharged to the Clarion River by these six tributaries during the 1966 survey.

The FWPCA and the Pennsylvania Department of Health conducted a cooperative survey during 1967 to locate and quantify the sources of mine drainage in the six tributary problem areas. More than 23 million gallons per day (mgd) of acid drainage was measured flowing from nearly 500 sources. This discharge carried a total acid load of 77 tons to the receiving streams. Less than one percent of the acid load was discharged from active coal mines. (See Appendix I)

A preliminary analysis of the mine drainage source inventory data indicates that physical abatement of about 10 percent of the total number of sources measured would achieve near-alkaline conditions in the lower reach of the Clarion River. Based on flow and water quality conditions at the time of the 1966-67 surveys, physical abatement of 45 discharges (at assumed abatement efficiencies for each source) would reduce the acidity content of the Clarion River near its mouth by about 75 percent.

The mine drainage source inventory work disclosed that, in the Licking and Mill Creek watersheds, acid discharged from abandoned gas wells is an additional, very sizeable source of stream water quality degradation. Abatement of some of these sources is desirable to complement acid reductions from coal mine sources. Complete data regarding gas well locations and discharge characteristics is not available at this time.

Achievement of the 75 percent reduction of the acid load in the lower Clarion River, through source abatement, would result in decreased acidity concentrations and increased alkalinity concentrations. Resultant acidity levels through reductions effected from stream conditions measured in 1966 in the lower Clarion River would be less than 10 mg/l. Corresponding pH values are expected to be neutral. Attendant reductions in concentrations of mine drainage-related constituents should result in acceptable levels for most water uses.

Water Quality Objectives

The State of Pennsylvania has submitted proposed water quality standards and an implementation plan in accordance with the Federal Water Pollution Control Act of 1965. These standards, applying to interstate waters, are currently under review.

Pennsylvania has established the following uses to be protected in the Allegheny River from Redbank Creek to Pittsburgh: warm water fish, domestic and industrial water supply, livestock and wildlife watering, irrigation, boating, fishing, water contact sports, natural area, power, navigation and treated waste assimilation.

To protect these uses, the following criteria have been proposed:

Allegheny River from the Kiskiminetas River to the Mouth

pH - not less than 6.0; not more than 8.5

Dissolved Oxygen - minimum daily average 5.0 mg/l; no value less than 4.0 mg/l

Total iron - not to exceed 1.5 mg/l

Temperature - not to exceed 5° F rise above ambient temperature or a maximum of 87° F whichever is less; not to be changed by more than 2° F during any one hour period.

Dissolved Solids - not to exceed 500 mg/l as a monthly average value; not to exceed 750 mg/l at any time.

Threshold Odor Number - not to exceed 24 at 60° C

Total Manganese - not to exceed 1.0 mg/l

Allegheny River from Redbank Creek to the Kiskiminetas River

Same as above except delete criteria for threshold odor number and total manganese.

For the Ohio River from Pittsburgh to the State line, Pennsylvania has established the same uses as in the lower Allegheny. Criteria proposed to protect these uses are the same as those proposed for the lower Allegheny with the addition of fluoride not to exceed 1.0 mg/l and phenol not to exceed 0.005 mg/l.

Pennsylvania's implementation plan for Allegheny River calls for primary treatment from Redbank Creek to the Kiskiminetas River and "intermediate" treatment from the Kiskiminetas River to the mouth. For the Ohio River from Pittsburgh to the State line, secondary treatment is required although present stream classification calls for primary treatment in Beaver County and intermediate treatment in Allegheny County. Table 7 presents the present status of municipal sewerage facilities in the study area.

Present FWPCA policy calls for a minimum of secondary treatment for all biodegradable wastes with an equivalent high degree of treatment for other wastes. Minor changes in criteria may be required at some future time.

TABLE 7

MUNICIPAL SEWERAGE FACILITIES

Municipality	Present Population Served	Present Treatment*	Receiving Stream	Mile Point
Emlenton	844	P	Allegheny River	92
Foxburg	383	None	Allegheny River	88
Parker	950	None	Allegheny River	84
East Brady	2734	None	Allegheny River	69
Templeton	900	None	Allegheny River	54
Kittanning	6790	P-C	Allegheny River	44
West Kittanning	1200	None	Allegheny River	44
Applewold	490	None	Allegheny River	44
Ford City	6000	P-C	Allegheny River	41
Freeport	2430	P-C	Allegheny River	29
U.A.J.S.A.	8230	I-C	Allegheny River	21
New Kensington	23,500	I-C	Allegheny River	18
A.V.J.S.A.	12,000	I-C	Allegheny River	13
Al.Co.San.A.	1,250,000	I-C[1/]	Ohio River	3.2
Oakmont	8,000	I-C	Allegheny River	12

TABLE 7 (continued)

Municipality	Present Population Served	Present Treatment	Receiving Stream	Mile Point
Corapolis	23,800	I-C	Ohio River	10
Sewickley	6766	I-C	Ohio River	12

*P - Primary I - Intermediate C - Chlorination

1/ BOD_5 removal normally less than 50%

Water Supply Needs

The present and projected individual municipal and industrial water supply requirements were compared to the existing low flow conditions of the supply source. Those users who obtain their supplies from existing navigation pools are guaranteed an adequate supply; if water needs exceed river flow, the water is merely reused.

The largest single user of Allegheny River water by the year 2020 is expected to be the city of Pittsburgh, Pennsylvania. Its projected total requirement of 130 million gallons per day (mgd) will exceed that of any other potential single municipal or industrial user along the Allegheny River. The existing water resources of the Allegheny River are more than adequate to meet this projected requirement.

Projected water requirements of Clarion, Pennsylvania, exceed the estimated reliable yield of their present source. Therefore, the community will probably change its source and obtain water from the Clarion River. The low flow conditions of the Clarion River are sufficient to meet the projected needs of the area.

The community of Butler, Pennsylvania, will need to obtain additional amounts of water from sources other than the Connoquenessing Creek in order to meet projected water needs. The present water withdrawal from the Allegheny River is limited to 5.5 mgd, or 0.5 percent of the existing reliable flow. If all of the projected additional water needs were met from the Allegheny River, the withdrawal rate would increase to 2.5 percent of the existing reliable flow; thus, present streamflow conditions are adequate.

In summary, it appears that the existing reliable streamflow, with Allegheny River Reservoir in operation, is adequate to meet the projected municipal and industrial water supply requirements of the study area.

Water Quality Control Needs

An analysis of total streamflow needed to maintain proper assimilation of organic wastes, assuming secondary treatment at the waste source, was made on the Allegheny and Ohio Rivers. The major rivers of the study area were divided into reaches in order to better assess the accumulative effect of projected municipal and industrial wastes on stream dissolved oxygen.

Water quality control flows are based on the collection and treatment of all wastes. Maintenance of suitable water quality requires that at least 85 percent of the waste load, as measured by the five day Biochemical Oxygen Demand, is removed; that all settleable solids that will form putrescent or otherwise objectionable sludge deposits are removed; that oil scum, floating materials, and substances producing color and odor are removed to such degrees required to prevent unsightly or deleterious conditions; that all substances that are toxic or harmful to human, animal, plant or aquatic life by themselves or in combination are removed; that heated discharges will be sufficiently cooled before discharge to prevent stream impairment for other uses; and that harmful bacteria will be reduced in sufficient number to allow intended stream uses.

The present streamflow conditions of the Allegheny River can adequately provide proper assimilation of treated municipal and industrial wastes under present and projected conditions. The greatest concentration of organic waste loads is projected to occur in the lower reaches of the Allegheny River.

There is a need for low flow augmentation for water quality control in Connoquenessing Creek near Butler, Pennsylvania. This creek is presently

degraded by residual municipal and industrial wastes in that high nutrient levels cause serious algal blooms; also, during low flow periods the stream lacks sufficient capacity for proper waste assimilation. Alternative methods of pollution control must be considered in order to provide the most feasible solution to the problem. Since the surface water storage potential of the Connoquenessing Creek watershed is inadequate to meet the projected storage requirement needs, either complete treatment of wastes or surface storage outside the basin must be considered. If a suitable quality of water is impounded, the community of Butler, Pennsylvania, after studying the feasibility of such alternatives, may be interested in purchasing storage in the proposed St. Petersburg Reservoir for low flow augmentation. This could be accomplished by expanding the existing water conveyance system from the Allegheny River.

The Ohio River near Pittsburgh, Pennsylvania, will need additional streamflow to insure proper assimilation of projected (2020) municipal and industrial residual waste loads after treatment. The present scheme of existing and authorized reservoirs will not provide sufficient storage to satisfy future streamflow needs for water quality control. The inclusion of storage for water quality control in the proposed St. Petersburg Reservoir is contingent on improvement in existing water.

Population growth and the expected increase in industrial production, primarily in the chemical field as indicated by the benchmark projections, will tax the assimilative capacity of the Ohio River. Total flow requirements for quality control below Pittsburgh, Pennsylvania, as measured at the U.S.G.S. gage at Sewickley are as follows:

Projected Total Streamflow Requirements (cfs)
on the Ohio River at Sewickley, Pennsylvania

	1980	2000	2020
January	3800	4400	5250
February	3950	4550	5400
March	4150	4800	5700
April	4550	5300	6250
May	4950	5750	6800
June	5500	6350	7500
July	5700	6600	7800
August	5600	6450	7650
September	5300	6150	7250
October	4700	5450	6450
November	4200	4850	5750
December	3950	4550	5400

The Corps of Engineers, Pittsburgh District has completed several computer analyses of reservoir operation studies for the proposed St. Petersburg Reservoir. These analyses show the effects of reservoir regulation on streamflow conditions in the Allegheny and Ohio Rivers during the period 1929 to 1966. Results indicate that 110,000 acre feet of storage would be needed in the proposed St. Petersburg Reservoir to satisfy the projected total flow requirements by the year 2020 for nine out of ten years. This storage amount is based upon conditions as follows:

a. Existing reservoirs are operated according to original release schedules.

b. The authorized Rowlesburg Reservoir, which has 572,000 acre feet storage for water quality control, is in place and operated for low flow augmentation needs at Lock 2, Monongahela River.

c. The proposed St. Petersburg Reservoir has a total summer storage potential of 685,000 acre feet for recreation and water quality control.

As a prerequisite to inclusion of storage for water quality control in the proposed St. Petersburg Reservoir, the quality of the Clarion River must be improved by corrective measures applied to the existing coal mine drainage sources. Storage of water of the present quality of the Clarion River would be of little value for anticipated water quality control needs on the Ohio River at Pittsburgh, Pennsylvania, and, water oriented recreational usage would be restricted. Also, experience has shown that reservoirs constructed in areas affected by coal mine drainage may become progressively acidic.

Analyses of available stream quality and mine drainage source data indicates that water quality of the Clarion River could be enhanced to an acceptable level through a reasonable amount of mine drainage source abatement. Drainage abatement by physical construction measures at a minimum of 40 coal mining sites, five known abandoned gas well sites, and an additional undetermined number of abandoned gas and/or oil well sites, upstream of the St. Petersburg site, is expected to result in a significant water quality improvement in the lower Clarion River. On the average, it is expected that resultant acidity concentrations in the proposed reservoir area would be less than 10 mg/l, alkalinity concentrations would be greater than 10 mg/l, and pH values would be above 6.0. Attendant reductions in concentrations of mine drainage-related constituents should result in acceptable levels for most water uses.

Abatement costs for 45 principal acid sources upstream of the reservoir site are estimated, on a preliminary basis, at $3.0 million. (See Appendix I.)

A detailed engineering study is required to determine specific construction measures and costs at each site.

It is recommended that provision be made to include a proposed mine drainage source abatement program, at least as extensive as outlined in Appendix I, as an integral part of the proposed reservoir project.

Benefits

The low flow augmentation needs on the Ohio River at Pittsburgh, Pennsylvania can be met by construction of a single purpose reservoir containing 110,000 acre feet of storage for water quality control. Such a reservoir would be the least costly alternative method to solve projected quality problems.

Based upon reservoir cost estimates provided by the Corps of Engineers, Pittsburgh District, benefits are assessed as follows:

Total Construction Cost	O & M Annual Cost	Total Annual Cost 1/
$27,500,000	$69,000	$1,001,000

1/ Includes annual operation and maintenance costs.

Total annual cost was developed from annual operation and maintenance cost plus a 100 year amortization of capital costs at an interest rate of 3 1/4 percent. This average annual cost of a single purpose alternate reservoir for water quality control is considered to be the minimum benefits associated with meeting the needs from storage in the Allegheny basin.

Computations indicate that this additional storage will be required to meet low flow augmentation needs at Pittsburgh by the year 1980. It is estimated that actual construction of facilities to provide this storage could not be completed prior to the initial time of need. The benefits, therefore, were not discounted to reflect a time lag between completion of construction and initial flow augmentation needs.

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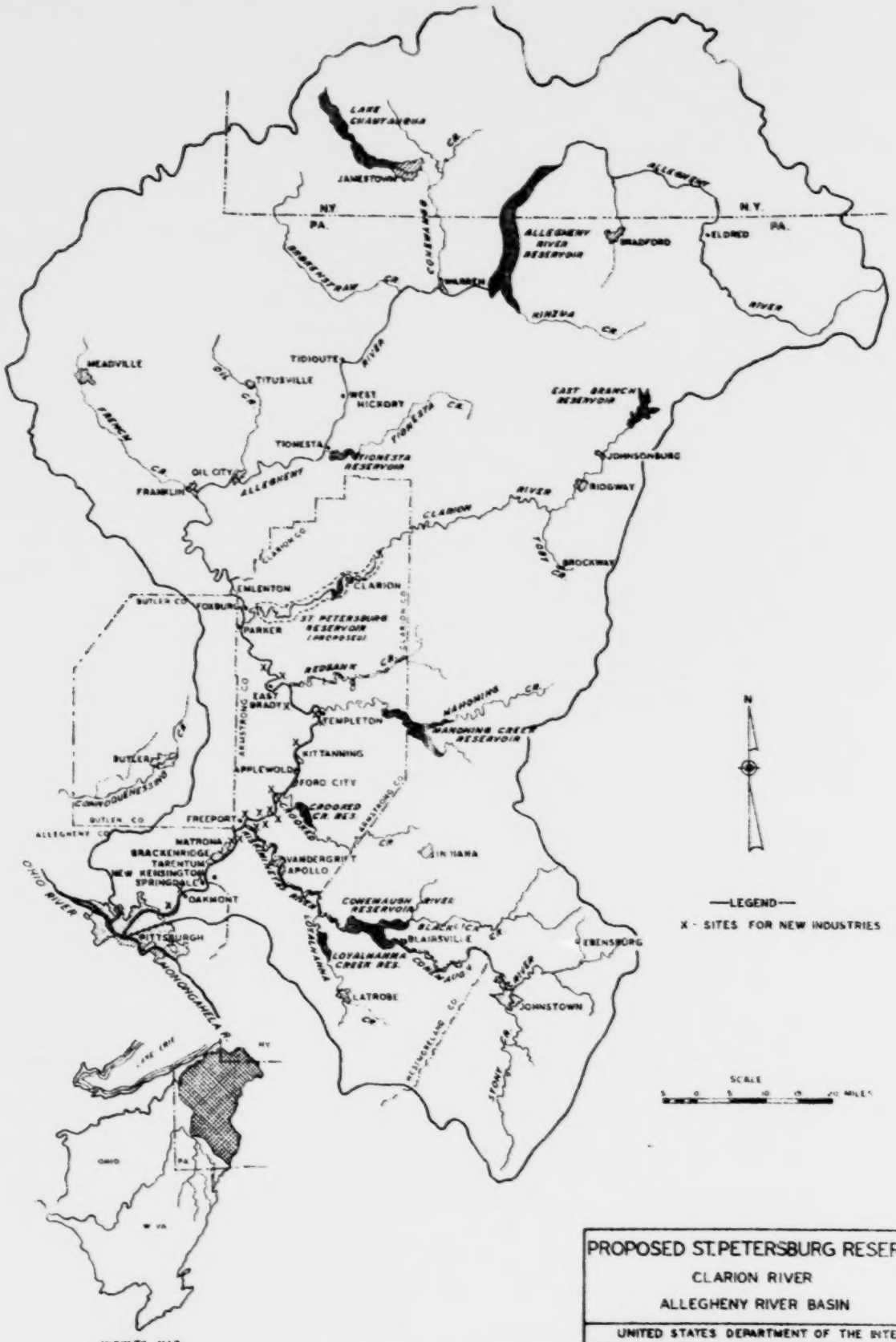


PROPOSED ST. PETERSBURG RESERVOIR

CLARION RIVER

ALLEGHENY RIVER BASIN

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
WHEELING FIELD STATION – OHIO BASIN REGION

FIGURE 1

APPENDIX I

CLARION RIVER BASIN

MINE DRAINAGE SOURCE INVESTIGATION

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

TOBY CREEK WATERSHED (JEFFERSON COUNTY) SUMMARY

Drainage Area:	125 square miles
Location:	Clarion River Milepoint 80.2
Net Acid Load (at mouth)[1/ 2/]:	14,936 lbs./day
Number of Sources Investigated:	185
Number of Sources Discharging:	113
Total Source Acid Load Measured:	38,089 lbs./day
Major Acid Load Source Category:	Underground mines
Principal Sources:	Mine numbers 920, 921, 926, 939, 954, 958, 960, 946, 984, 996, 998, 1187
Preliminary Abatement Cost Estimate, Principal Sources:	$200,000

Remarks: Three active drift mines in the watershed discharged a total acid load during the survey of only 143 lbs./day. All other discharges measured were from inactive or abandoned mine sites.

The acid load of the 12 principal sources totals 30,045 lbs./day, about 80 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs/day
1.	920	Drift	Limestone Run	387	2.9	1650	765	3,553
2.	921	Drift	Limestone Run	387	2.9	1500	545	2,531
3.	926	Drift	Toby Creek	180	3.0	1500	730	1,577
4.	939	Strip-(Comb.)*	Kyler Run	380	3.9	1400	310	1,410
5.	954	Deep	Kyler Run	90	2.6	3000	1455	1,555
6.	958	Deep (Comb.)**	Unnamed Trib.	170	5.5	2200	490	1,000
7.	960	Drift	Toby Creek	400	3.5	1200	315	1,512
8.	946	Drift-(Comb.)	Kyler Run	1323	3.2	1300	300	4,761
9.	984	Drift	Unnamed Trib.	635	4.6	1600	465	3,543
10.	996	Drift-(Comb.)	Unnamed Trib.	1152	2.8	1200	290	4,009
11.	998	Drift	Brandy Camp Cr.	220	3.1	1400	390	1,030
12.	1187	Drift	Toby Creek	440	2.8	2500	675	3,564
							TOTAL	30,045

*Combination Strip Mine. Strip and underground mines together with principal portion of discharge from the strip mine.

**Combination Underground Mine. Strip and underground mines together with principal portion of discharge from the underground mine.

If physical abatement measures were constructed to achieve drainage quality control at the 12 sites indicated, Toby Creek (Elk and Jefferson Counties) could discharge only a very minor acid load to the Clarion River.

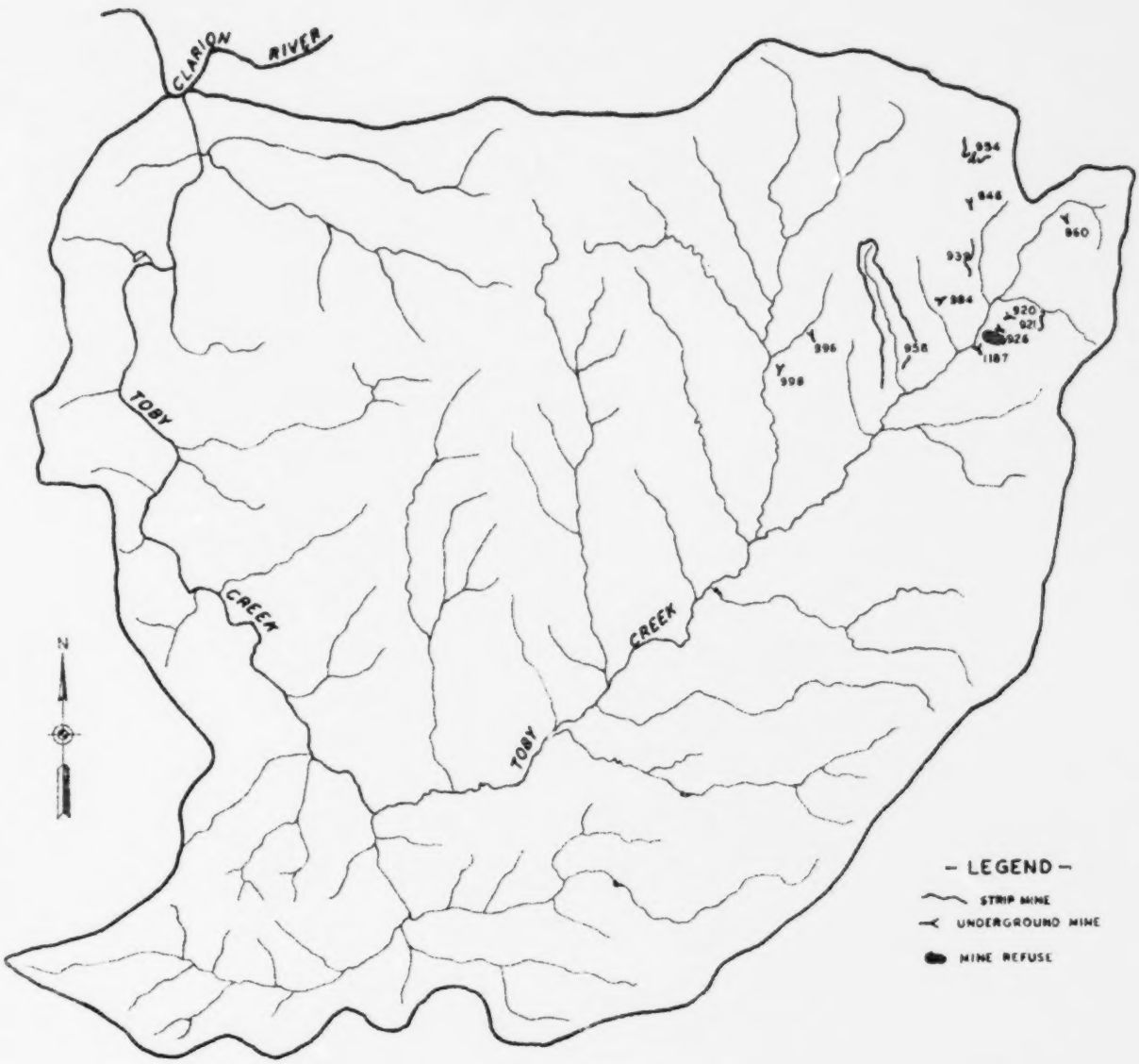
If an overall 50 percent reduction in acid discharge from these 12 sites could be achieved by the mine sealing and related construction, their total load would be cut to 15,000 lbs./day acidity. This load is just about the cumulative residual load measured at the mount of Toby Creek. If only 25-30 percent reductions were possible, the watershed acid contribution to the Clarion would be reduced by at least one-half.

Although Clarion River pollution from this watershed is far removed from the proposed reservoir boundaries, acid drainage reduction in Toby Creek would bequeath a greater alkaline reserve to the Clarion which would enable it to assimilate larger acid loads downstream.

The above mine sites selected for acid drainage abatement are suggested to achieve the minimum effect of reducing or eliminating the cumulative acid load residual at the mouth of the watershed. Abatement of polluted conditions in the entire watershed or any portions thereof would be a much larger task.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the 12 principal sources in $200,000. A detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the 12 principal sources in the Toby Creek (Jefferson County) watershed are shown on Figure 2.



SCALE
1 0 1 2 3 4 MILES

PRINCIPAL MINE DRAINAGE SOURCES
TOBY CREEK JEFFERSON CO.

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION WHEELING FIELD STATION

FIGURE 2

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

TOBY CREEK WATERSHED (CLARION COUNTY) SUMMARY

Drainage Area:	37 square miles
Location:	Clarion River Milepoint 30.0
Net Acid Load (at mouth): [1/] [2/]	47,582 lbs./day
Number of Sources Investigated:	99
Number of Sources Discharging:	81
Total Source Acid Load Measured:	79,784 lbs./day
Major Acid Load Source Category:	Strip mines
Principal Sources:	Mine numbers 1015, 1023, 1029, 1031, 1040, 1044, 1058
Preliminary Abatement Cost Estimate, Principal Sources:	$350,000

Remarks: Active mines in the watershed (strip mines) were not contributing acid drainage to streams at the time of the survey. One operation was discharging alkaline water.

The acid load of the seven principal sources totals 72,494 lbs./day, about 90 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs/day
1.	1015	Drift-(Comb.)*	Unnamed Trib.	207	3.4	1050	465	1155
2.	1023	Strip	Toby Creek	500	2.7	9000	8330	49,980
3.	1029	Strip	Rapp Run	60	2.8	8250	7600	5,472
4.	1031	Strip	Rapp Run	65	2.8	7000	6365	4,965
5.	1040	Strip	Unnamed Trib.	65	2.9	3000	6200	4,836
6.	1044	Strip	Unnamed Trib.	45	2.8	7800	7380	3,985
7.	1058	Strip	Unnamed Trib.	45	2.5	3000	3890	2,101
							TOTAL	72,494

*Combination Drift Mine. Strip and drift mines together with principal portion of discharge from the drift mine.

If physical abatement measures were imposed at these seven areas of the total 81 source areas surveyed, Toby Creek could be an alkaline stream at its confluence with the Clarion River.

Since six of the seven sources are of surface mine origin, a resultant high percentage reduction in acid load from each would be expected after application of known abatement or reclamation techniques. Assuming an overall acid load reduction of about 75 percent, the cumulative residual acid load discharged to the Clarion River should be at or near zero on the average.

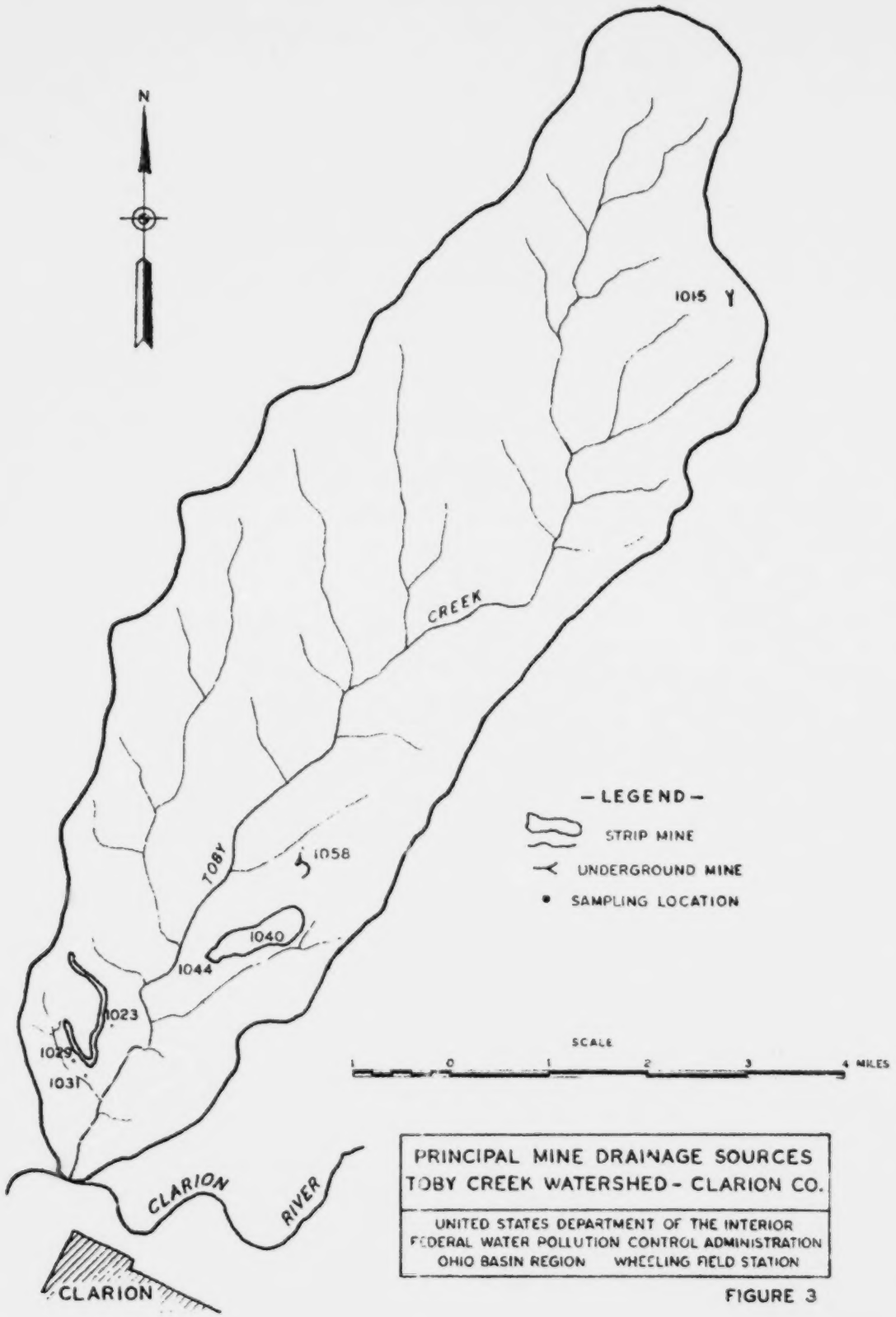
Acid load fluctuations after source abatement would result through the year as a function of hydrologic conditions. However, the stream's

maximum acid discharge under the most adverse hydrologic conditions would be expected to be a fraction of the present situation.

The above mine sites selected for acid drainage abatement are suggested to achieve the minimum effect of reducing or eliminating the cumulative acid load residual at the mouth of the watershed. Abatement of polluted conditions in the entire watershed or portions thereof would be a much larger task.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the seven principal sources is $350,000. A detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the seven principal sources in the Toby Creek (Clarion County) watershed are shown on Figure 3.



PRINCIPAL MINE DRAINAGE SOURCES
TOBY CREEK WATERSHED - CLARION CO.

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION WHEELING FIELD STATION

FIGURE 3

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

PINEY CREEK WATERSHED SUMMARY

Drainage Area:	70 square miles
Location:	Clarion River Milepoint 21.6
Net Acid Load (at mouth): [1/] [2/]	19,272 lbs./day
Number of Sources Investigated:	130
Number of Sources Discharging:	75
Total Source Acid Load Measured:	10,995 lbs./day
Major Acid Load Source Category:	Strip mines
Principal Sources:	Mine numbers 1173, 4208, 4216
Preliminary Abatement Cost Estimate, Principal Sources:	$150,000

Remarks: Two active strip mines in the watershed were discharging a combined acid load of 1000 lb./day during the survey.

The acid load of the three principal sources totals 3,157 lbs./day, about 29 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs./day
1.	1173	Strip	Unnamed Trib.	252	2.9	2150	510	1542
2.	4208*	Strip	Unnamed Trib.	12	3.2	8000	5965	859
3.	4216	Strip	Unnamed Trib.	180	4.5	1800	350	756
							TOTAL	3157

*Some active stripping in area at time of survey.
1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

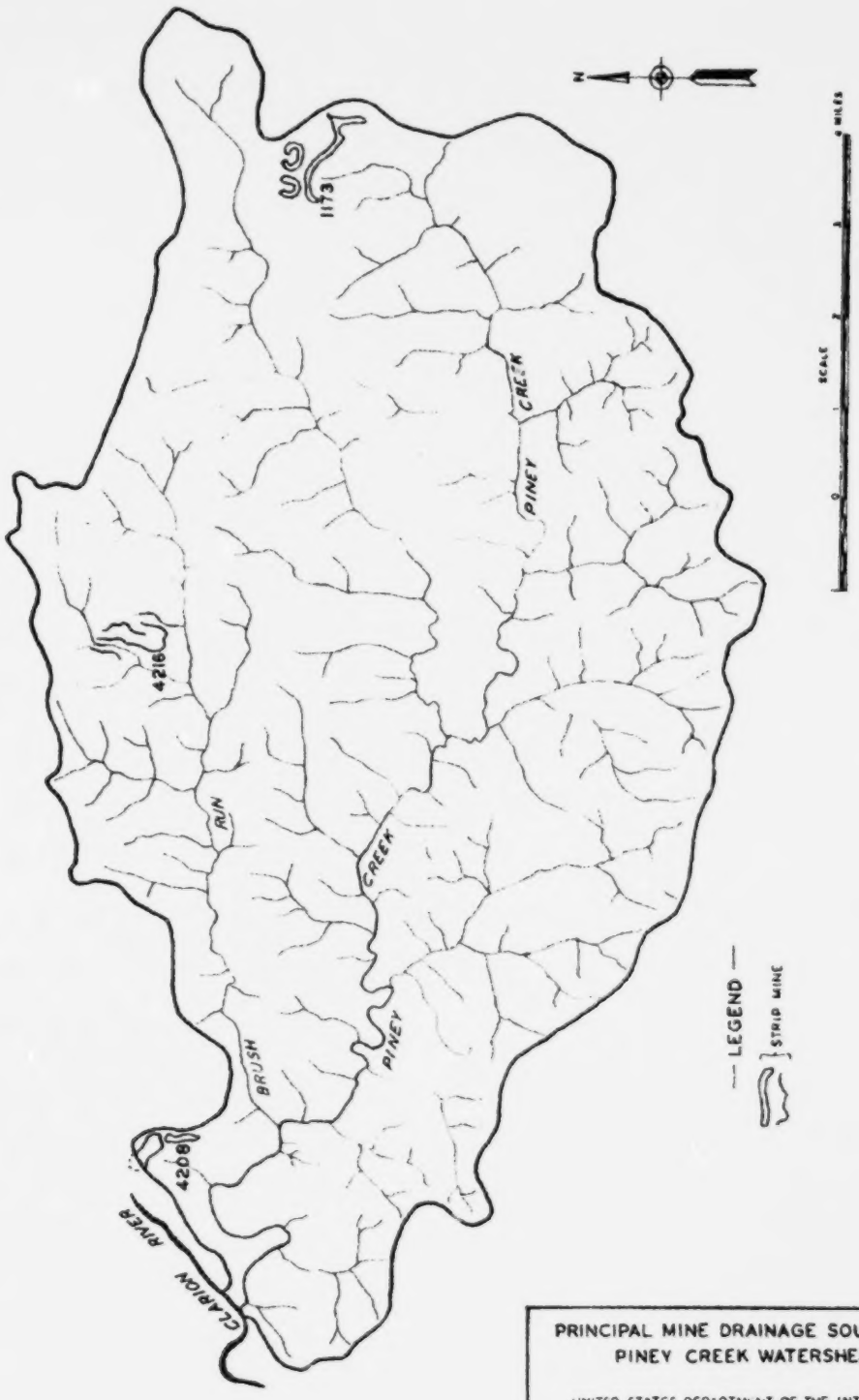
At the time of the mine drainage source investigation (low flow conditions), Piney Creek discharged an acid load of only 1,638 lbs/day. However, the 1966 stream survey, conducted under varying flow conditions, measured an average Piney Creek discharge of 19,272 lbs./day. Based on the acid loading at the low flow condition measured (1,638 lbs./day), elimination of the three listed principal sources would result in alkaline conditions at the mouth of Piney Creek.

The limited stream data indicate that abatement of additional sources may be necessary to effect alkaline conditions at greater than low flow or base flow stream conditions.

The above mine sites selected for acid drainage abatement are suggested to achieve the minimum effect of reducing or eliminating the cumulative acid load residual at the mouth of the watershed. Abatement of polluted conditions in the entire watershed or any portions thereof would be a much larger task.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the three principal sources is $150,000. A detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the three principal sources in the Piney Creek watershed are shown on Figure 4.



PRINCIPAL MINE DRAINAGE SOURCES
PINEY CREEK WATERSHED

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION WHEELING FIELD STATION

FIGURE 4

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

MILL CREEK WATERSHED SUMMARY

Drainage Area:	56 square miles
Location:	Clarion River Milepoint 35.0
Net Acid Load (at mouth): [1/] [2/]	16,960 lbs./day
Number of Sources Investigated:	26
Number of Sources Discharging:	18
Total Source Acid Load Measured:	6,805 lbs./day
Major Acid Load Source Category:	Strip Mines
Principal Sources:	Mine numbers 4242, 4284, 4356, 4357
Preliminary Abatement Cost Estimate, Principal Sources:	$780,000

Remarks: No active mine discharges existed in the watershed at the time of the survey.

The acid load of the four principal sources totals 6,382 lbs./day, about 94 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs/day
1.	4242	Strip	Unnamed Trib.	30	4.0	2800	883	318
2.	4284	Strip	Unnamed Trib.	95	3.2	5000	3740	4264
3.	4356	Strip	Jones Run	60	3.4	2800	1260	907
4.	4357	Strip	Jones Run	80	3.4	2000	930	893
							TOTAL	6382

Mill Creek discharged to the Clarion River a net acid load of 16,960 lbs./day during the 1966 survey. The mine drainage source investigation measured 6,805 lbs./day of acid being discharged from 16 strip mines in the watershed. (A small acid load was also measured from two abandoned gas wells.)

The stream survey measured some 10,000 lbs./day of acid in Mill Creek that is not accounted for in the source inventory. This large difference between the values is believed to be the result of abandoned oil and gas well discharges in the basin, similar to coal mine discharges in chemical character, that were not documented in the source investigation survey.

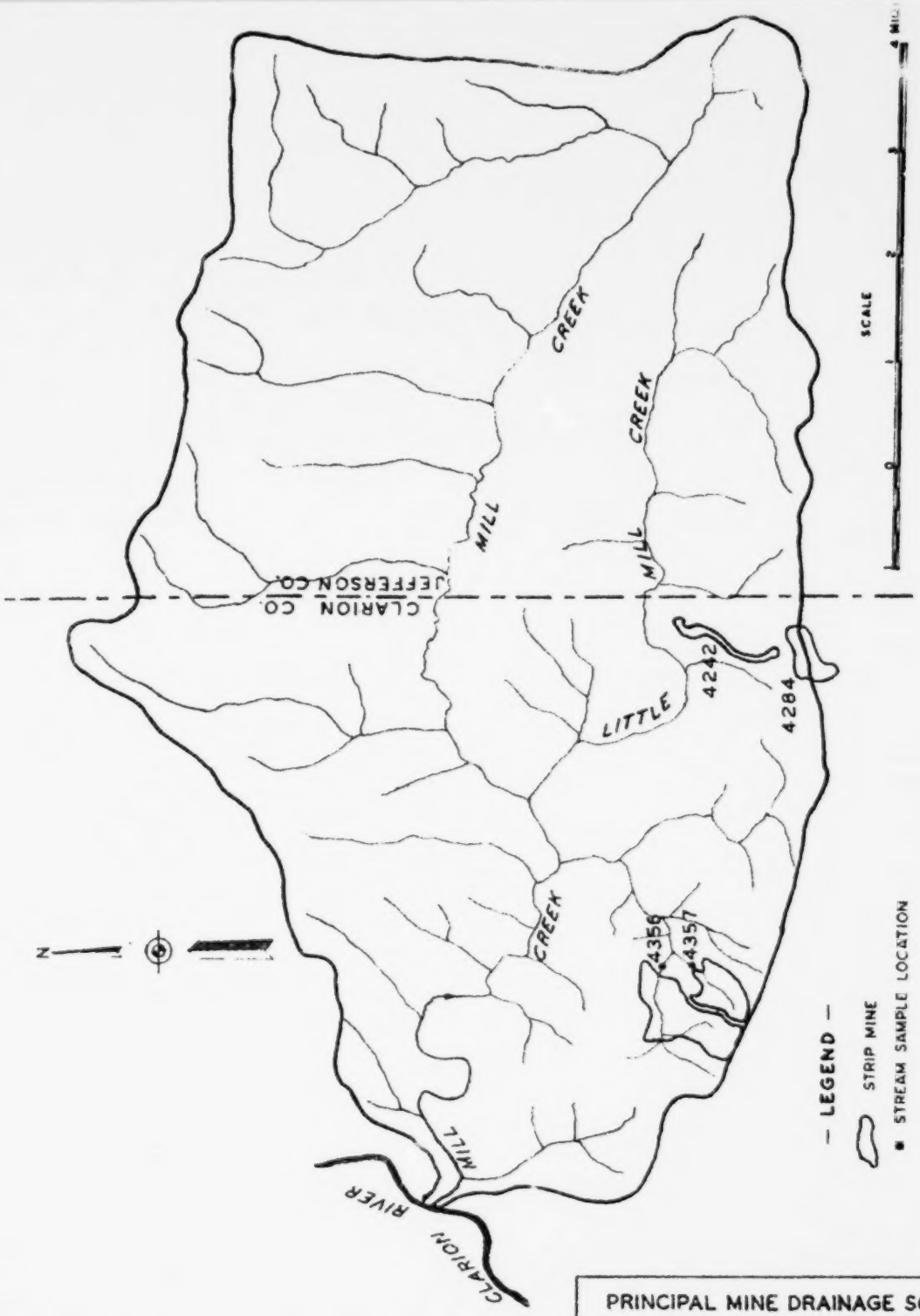
Because of the acid present in Mill Creek that is of an assumed origin, the number of sources needed to be abated to eliminate the acid load discharged to the Clarion River is not available at this time. An additional field survey to locate and quantify the oil and gas well sources would be required to develop this data.

Complete elimination of drainage from the four strip mine areas listed as principal sources would effect an approximate 38 percent reduction in

acidity discharged to the Clarion River. It is expected that plugging or other suitable physical measures employed at the abandoned oil and/or gas wells that are yet to be investigated will result in zero or near-zero acidity discharged to the Clarion River from this watershed.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the four principal sources is $780,000. A detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the four principal sources in the Mill Creek watershed are shown on Figure 5.



PRINCIPAL MINE DRAINAGE SOURCES
MILL CREEK WATERSHED

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION - WHEELING FIELD STATION

FIGURE 5

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

LICKING CREEK WATERSHED SUMMARY

Drainage Area:	52 square miles
Location:	Clarion River Milepoint 14.8
Net Acid Load (at mouth): [1/] [2/]	16,850 lbs./day
Number of Sources Investigated:	212
Number of Sources Discharging:	130
Total Source Acid Load Measured:	6,670 lbs./day
Major Acid Load Source Category:	Strip mines, underground mines
Principal Sources:	Mine numbers 1227, 4314, 4317, 4476, 4477, 4485, 4491, 4564, 4566, 4567, 4568, 4572, 4599.
Preliminary Abatement Cost Estimate, Principal Sources:	$950,000

Remarks: One active drift mine discharged a daily acid load of 103 pounds in the watershed at the time of the survey. All other measured discharges were from inactive or abandoned sites.

The daily acid load of the 13 principal sources totals 4,059 pounds, about 60 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs/day
1.	1227	Strip	Cherry Run	40	6.6	2750	410	197
2.	4314	Strip	Unnamed Trib.	4	2.8	6000	5070	243
3.	4317	Drift	Licking Creek	15	3.0	5000	1930	347
4.	4476	Drift-Comb.	Unnamed Trib.	85	3.1	1950	365	372
5.	4477	Drift-Comb.	Unnamed Trib.	85	3.3	2100	440	449
6.	4485	Strip	Little Licking Cr.	25	3.3	3600	1425	428
7.	4491	Gas Well	Little Licking Cr.	12	4.4	6500	4635	667
8.	4564	Strip	Anderson Run (Est.)	8	2.9	3800	1610	155
9.	4566	Drift	Unnamed Trib.	35	3.9	1900	470	197
10.	4567	Drift	Mineral Run	30	3.0	3800	970	349
11.	4568	Drift	Mineral Run	15	3.0	3000	1295	214
12.	4572	Strip	Mineral Run	5	3.5	6000	3220	199
13.	4599	Strip	Anderson Run	8	3.2	6000	2525	242
							TOTAL	4059

*Combination Drift Mine. Strip and drift mines together with principal portion of discharge from the drift mine.

Licking Creek discharged a net acid loading to the Clarion River of 16,850 lbs./day during the 1966 survey. The mine drainage source investigation measured 6667 lbs./day being discharged from the 129 coal mine sources and one abandoned gas well in the watershed.

The stream survey measured some 10,000 lbs./day of acid in Licking Creek that is not accounted for in the source inventory. This large difference

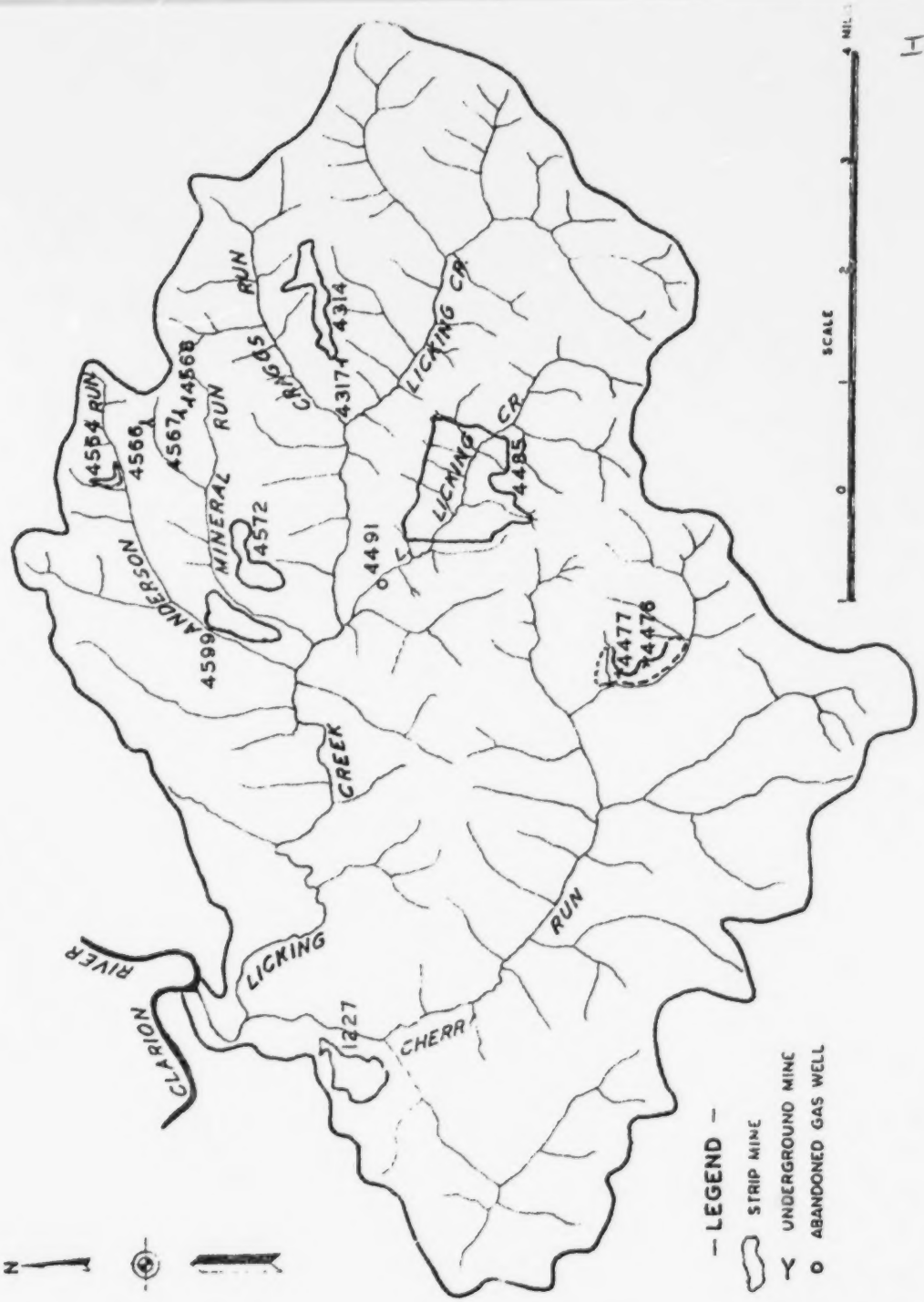
between the values is believed to be the result of abandoned oil and gas well discharges in the basin, similar to coal mine discharges in chemical character, which were not documented in the source investigation survey.

Because of the acid present in Licking Creek that is of an assumed origin, the absolute number of sources needed to be abated to eliminate the acid load discharged to the Clarion River is not available at this time. An additional field survey to locate and quantify the oil and gas well sources would be required to develop this data.

Assuming complete elimination of gas well and strip mine discharges, and a 50 percent reduction of acid load from drift mine discharges, physical abatement of the 13 listed principal sources would reduce the acidity entering the Clarion River from this watershed only about 17 percent. It is expected that plugging or other suitable physical measures employed at the abandoned oil and/or gas wells that are yet to be investigated, will result in zero or near-zero acidity discharged to the Clarion River from this watershed.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the 13 principal sources is $950,000. A detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the 13 principal sources in the Licking Creek watershed are shown on Figure 6.



PRINCIPAL MINE DRAINAGE SOURCES
LICKING CREEK WATERSHED

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION WHEELING FIELD STATION

FIGURE 6

FWPCA

WHEELING FIELD STATION

MINE DRAINAGE SOURCE INVESTIGATION

DEER CREEK WATERSHED SUMMARY

Drainage Area:	69 square miles
Location:	Clarion River Milepoint 21.3
Net Acid Load (at mouth) [1/ 2/]	13,845 lbs./day
Number of Sources Investigated:	89
Number of Sources Discharging:	57
Total Source Acid Load Measured:	10,752 lbs./day
Major Acid Load Source Category:	Oil and gas wells, underground mines.
Principal Sources:	Mine numbers 1043, 4253, 4337, 4516, 4531, 4532
Preliminary Abatement Cost Estimate, Principal Sources:	$24,000

Remarks: The only discharge encountered from an active operation was a 324 lbs./day acid loading from an active coal washery lagoon overflow.

The acid load of the six principal sources totals 6,773 lbs/day, about 75 percent of the total watershed source load measured. Pertinent data regarding the principal sources is given in the following table:

PRINCIPAL SOURCES

	Mine No.	Type	Receiving Stream	Flow (gpm)	pH	Specific Conductance	Acidity mg/l	Acidity lbs/day
1.	1043	Drift	Unnamed Trib.	16	2.6	6000	4360	837
2.	4253	Drift	Little Paint Creek	18	2.7	>8000	9235	1995
3.	4337	Gas Well	Judith Run	100	5.3	2400	740	888
4.	4516	Gas Well	Frills Run	120	5.4	1700	430	619
5.	4531	Gas Well	Unnamed Trib.	495	2.5	1275	290	1723
6.	4532	Gas Well	Unnamed Trib.	212	2.6	1200	280	711
							TOTAL	6773

1/ Acid Load Minus Alkaline Load.
2/ Average of Six Samplings, 1966.

Deer Creek discharged a net acid load to the Clarion River of 13,845 lbs./day during the 1966 survey. The mine drainage source investigation measured 10,752 lbs./day being discharged from 57 coal mines and abandoned oil and gas wells in the watershed. Four of the six principal sources listed are abandoned gas wells. The acid load from these four wells amounts to more than one-third of the total load measured from 57 coal mine and oil and gas well sources.

The stream survey measured some 3,000 lbs./day in Deer Creek that is not accounted for in the source inventory. This difference between the values is believed to be the result of abandoned oil and gas well discharges in the basin, similar to coal mine discharges in chemical character, which were not documented in the source investigation survey.

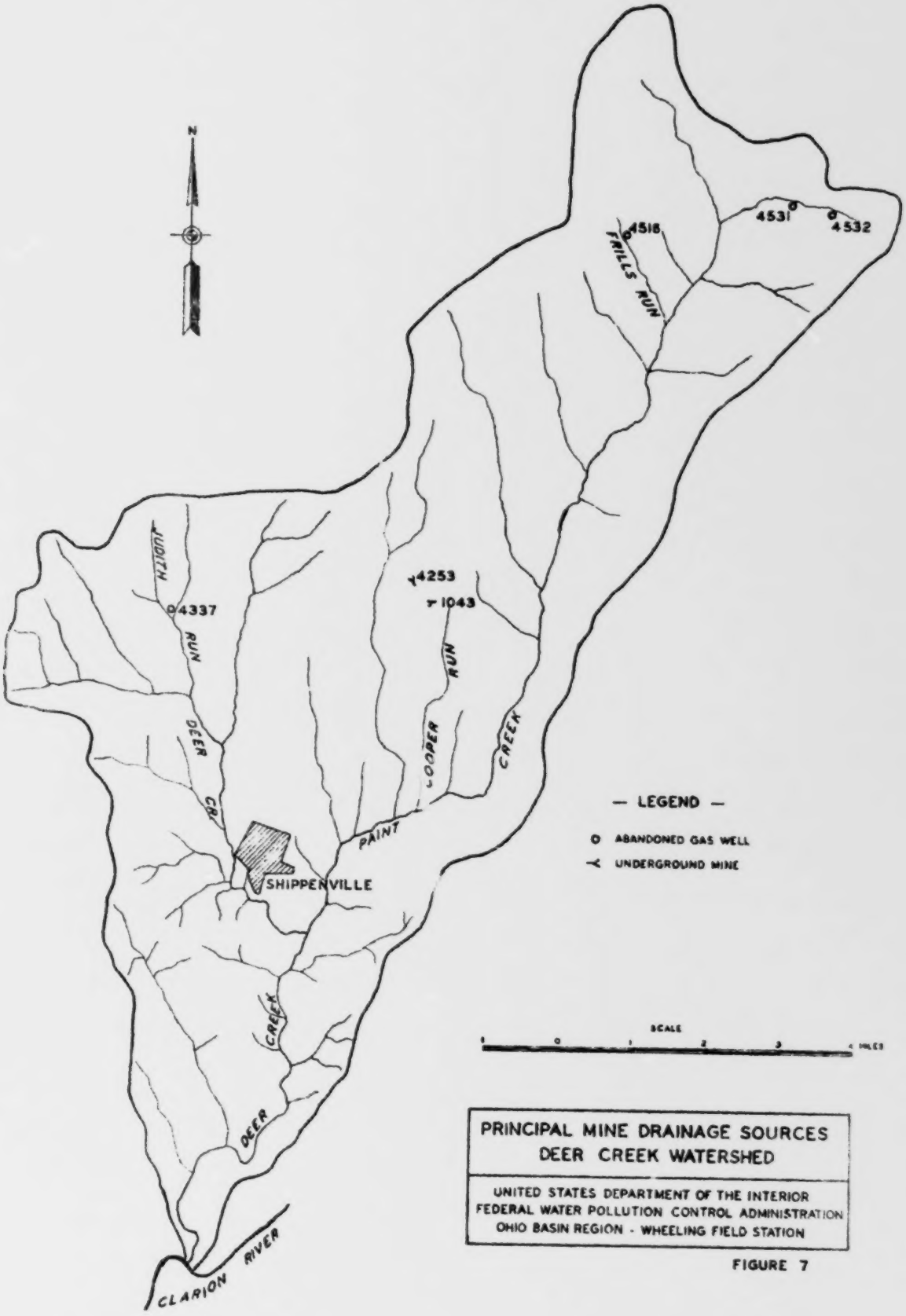
Because of the acid present in Deer Creek that is of an assumed origin, the absolute number of sources needed to be abated to eliminate the acid load discharged to the Clarion River is not available at this time. An additional field survey to locate and quantify the oil and gas well sources would be required to develop this data.

Assuming complete elimination of gas well discharges and 50 percent acid reductions from drift mine discharges, physical abatement of the six listed principal sources would reduce the acidity entering the Clarion River from this watershed about 40 percent. It is expected that plugging or other suitable physical measures employed at the abandoned oil and/or gas wells that are yet to be investigated will result in zero or near-zero acidity discharged to the Clarion River from this watershed.

A gross preliminary estimate of the cost of physical measures to control or reduce the pollutant effect of the six principal sources is $24,000. A

detailed engineering study is required to determine feasible construction measures and costs at each site.

The locations of the six principal sources in the Deer Creek watershed are shown on Figure 7.



PRINCIPAL MINE DRAINAGE SOURCES
DEER CREEK WATERSHED

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OHIO BASIN REGION - WHEELING FIELD STATION

FIGURE 7

ABATEMENT EFFECTS ON CLARION RIVER

The following table lists the average net acid loading values for the Clarion River at mouth and for its six principal acid-polluted tributaries. The values are averages of six samplings during summer, 1966:

STREAM LOCATION:	AVERAGE NET ACID LOAD (lbs./day)
Clarion River, at mouth.	126,712
Toby Creek (Clarion County) @ mouth.	47,582
Piney Creek @ mouth.	19,272
Licking Creek @ mouth.	16,850
Mill Creek @ mouth.	16,960
Deer Creek @ mouth.	13,845
Toby Creek (Jefferson County) @ mouth.	14,936

Using the principal sources listed for the six tributary watersheds (see individual watershed summaries), and the assumed acid reductions described for each watershed, the net acid load at the mouth of the Clarion River (table above) would be reduced to about 30,000 lbs./day. This level constitutes a 75 percent improvement over present conditions.

The principal sources listed for the Mill, Deer, and Licking Creek watersheds are the major acid contributors of the total number of sources identified in each watershed. Abatement of these principal sources would not effect alkaline conditions at the mouth of each drainage area. Assuming additional principal sources are identified in the Mill, Deer, and Licking Creek watershed, the contributions of these watersheds could be reduced to the point that the effect is essentially zero net acidity at the mouth of the Clarion River.

MINE DRAINAGE ABATEMENT COSTS

The preliminary cost estimates for abatement of the identified principal sources in the six tributary watersheds totals $2.45 million. This total has been rounded upward to $3.0 million to allow for abatement costs of presently unidentified abandoned oil and gas well sources.

THE OIL AND GAS WELL ACID POLLUTION PROBLEM

During the Clarion River mine drainage source investigation, abandoned oil and gas well discharges were sampled and measured when encountered in the coal mine areas. No specific attempt was made to locate such discharges during the mine drainage survey.

Thirty-five abandoned gas well discharges and one abandoned oil well discharge were documented in the field. A summary of pertinent data from the survey is tabulated below:

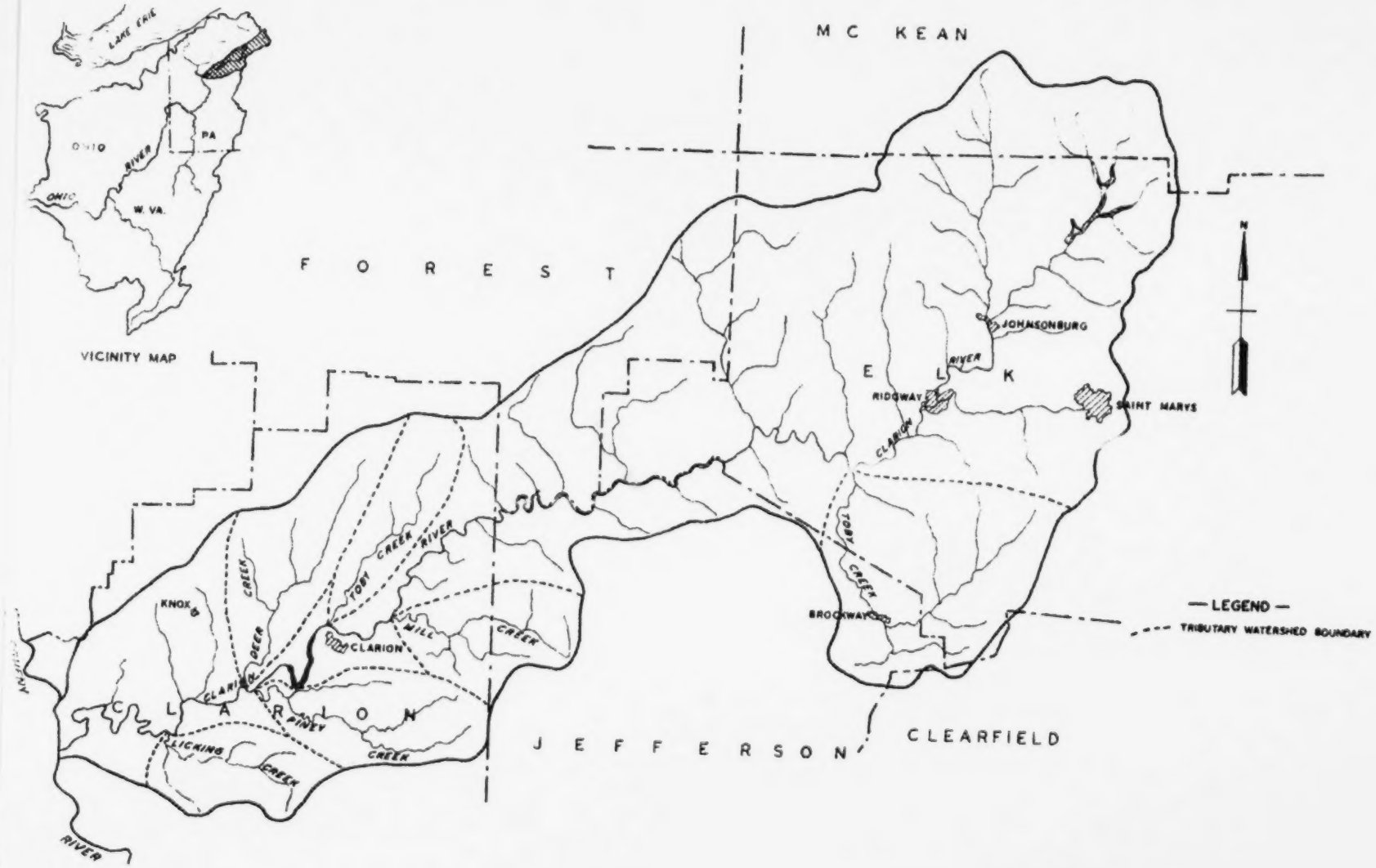
Watershed	Number of Wells	Flow range (gpm)	pH Range	Net acid load range (lbs./day)	Remarks
Toby Creek (Clarion County)	15	1-90	2.8-7.3	0-511	(23 of the 35 well discharges had pH values below 6.0)
Piney Creek	5	1-50	3.1-7.0	0-66	
Mill Creek	3	4-7	3.1-5.2	0-43	
Licking Creek	1	12	4.4	667	
Deer Creek	12	1-495	2.5-7.0	0-1722*	

*The second largest acid load source measured in the Deer Creek watershed, 1722 lbs./day.

Examination of a recent study made in this immediate area indicates the average density of abandoned oil and gas wells (mostly gas wells) in this area to be about 11 per square mile. (U.S. Bureau of Mines report to the Corps of Engineers, Pittsburgh District, concerning the proposed St. Petersburg reservoir.) Assuming this density to persist in the drainage areas of Mill, Licking, and Deer Creeks, nearly 2000 wells exist in the 177 square mile area. If only five percent of these have acid discharges, this would amount to about 100 sources in addition to coal mine sources.

The status of available data on these abandoned features is such that location and sampling in the field is the only way they can be documented.

Stream and coal mine discharge data comparisons in the Licking and Mill Creek watersheds suggest that abandoned gas well discharges are the principal sources of acid.



TRIBUTARY WATERSHEDS STUDIED
CLARION RIVER BASIN

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FIGURE 8